Closely Spaced Parallel Approaches Issues Version 2 Nov. '98

Introduction

This document outlines the issues raised in the Closely-Spaced Parallel Approaches Operations Concept, Version 2, September 1998.

<u>1.1.2A GLS Approaches and Navigation Performance</u>

Description: Can/should CSPA approach geometry be exactly the same as GLS approach geometry? How do we make best use of the available GLS navigation accuracy to "prevent the blunder", in keeping with CSPA philosophy?

Discussion: As discussed in the OpsCon, the angular Localizer approach is unsuitable for CSPA, since the beams will overlap before the outer marker (Final Approach Way Point, FAWP in GLS parlance) for runway separations of interest. The new GLS approaches are being designed as ILS "look-alikes" with similar angular deviation indication. The angular nature of the localizer signal permits "capture" of the final approach course for aircraft being vectored onto it. DGPS allows for a final approach course of constant width, facilitating CSPA alerting for any aircraft not maintaining a track close to the runway extended centerline. The problem is to get both the easy "capture" of the final approach trajectory using an angular signal, AND the more accurate trajectory attainable from DGPS. More work is required on "capturing" the approach and exactly how and when the standard terminal separation requirement is given up for CSPA aircraft. "Capturing" the final approach could be facilitated by using an FMS transition from the STAR, but is this too restrictive to require it for a CSPA approach? Possibly the visual depiction of own ship relative to the final approach course at one or two mile range on the NAV display will provide sufficient guidance.

One of the problems with PRM is the high incidence of "nuisance alerts". This occurs when the combination of imperfect localizer accuracy plus navigation performance of the aircraft allows an aircraft to wander either side of the centerline sufficient to enter the NTZ, especially at the beginning of the final approach course near the outer marker. Navigation performance can be much improved using GLS, but we need to demonstrate that the expected accuracy will eliminate nuisance alerts. We also need some terminology to distinguish "wandering" due to poor navigation system performance from a true blunder. This came up at the WG-1 presentation.

The first CSPA alert threshold should be set so it goes off as soon as an aircraft's navigation performance is less than expected for GLS. Alerting for poor navigation performance will be required for a GLS approach anyway, especially if it is for a Cat II or III landing (isn't this done now for a Cat II or Cat III ILS?). We should coordinate with RTCA SC-159 on this. The objective here is to deal with the wandering aircraft before the deviation becomes a blunder. ATC intervention may be required, to either direct the aircraft back on course, or to require a missed approach.

<u>1.1.2B ADS-B Message Requirements</u>

Description: What are the required update rate, latency, reliability, and accuracy of the ADS-B message?
Discussion: The GLS signal will have sufficient accuracy, update rate, latency and reliability to allow for Cat II and Cat III landings. This should be more than sufficient for CSPA. However, the GLS signal from each aircraft is "packaged" for transmission via ADS-B to other aircraft, and thus loses much of the GLS signal capability, particularly update rate (see Table 3.4, ADS-B MASPS; see also analysis in Appendix J for CSPA). We need to firm up ADS-B requirements for WG-4, but this probably needs to wait on performing a sensitivity analysis to accuracy, update rate, latency etc. using the ASAT Monte Carlo simulation. Suggest for now we accept values recommended in the MASPS.

1.1.2C Alert Thresholds

Description: The CSPA alert thresholds need to be defined.

Discussion: The first alert stage to the deviating aircraft should be related to GLS navigation performance as noted above. The second alert to the deviating aircraft, with the instruction to execute a missed approach can be related both to navigation performance or time the deviation has continued. The alerts to the threatened aircraft need to be related both to a target level of safety and the allowable ratio of false alerts, both of which we will define based on the ASAT analysis.

1.1.2D Breakout Maneuver

Description: The breakout or escape maneuver needs to be evaluated.

Discussion: The present concept is for a single breakout maneuver, a climbing turn to 45^0 away from the parallel approach. Once established in the climbing turn, the flight crew contacts ATC for further instruction, just as is done now for a missed approach. There are several issues with this.

1. Does the single climbing turn produce the target level of safety? We are waiting on the ASAT analysis to answer this.

2. Even if the overall target level of safety is achieved (due to true blunders necessitating breakout of the parallel traffic being very rare), CSPA will probably be held to the same criteria as PRM; that is, it must resolve blunders with a high level of confidence. From the PRM Demonstration Report, PRM failed in resolving the blunder in only 1 in 250 "at risk" blunders. ("At risk" simply means the blunder would result in an NMAC if not resolved.) We would then need to show that the climbing turn resolved at least 99.6% of "at risk" blunders for CSPA.

3. The flight crew will need to know when the blunder is resolved. The current OpsCon suggests that the alerts cease only when the blunder is resolved. The alerting function could also provide a "clear of conflict" message. Either of these is the cue for the flight crew to contact ATC. (Is the criterion for "clear of conflict" divergence between the

aircraft or no projected conflict? Is there mathematically or practically a difference?) Should ATC not respond immediately with alternate instructions, the aircraft turns toward the missed approach fix and completes the missed approach procedure.

4. TCAS will be reinstated as soon as the breakout maneuver is completed, ie the aircraft has turned 45^0 from the runway heading and has reached some minimum altitude. We don't know if an RA could still be generated by the blundering aircraft once CSPA indicates the conflict is resolved (and this seems very unlikely) but should still be evaluated. If an unwanted RA could be generated, then reinstatement of TCAS could be delayed until the aircraft are beyond the RA threshold.

5. Since the breakout maneuver could occur at any point along the approach, a large volume of airspace outside of the approach must be kept clear, or evading aircraft could conflict with those on downwind. This will be a negative impact on airspace design so the time between an aircraft initiating a breakout maneuver and being turned away from the 45^0 breakout heading by ATC or by the aircraft joining the missed approach procedure should be minimized. This will be evaluated using the ASAT model.

6. If the breakout is initiated close to the Decision Height, the flight crew is probably going to want to establish a positive rate of climb before turning, no matter what. Flight crew compliance with the "turn climb" instruction near the Decision Height needs to be evaluated, as does the effect on safety of establishing a positive rate of climb before turning.

<u>1.1.2E TCAS Inhibit and Reinstatement for CSPA Aircraft</u>
Description: We need to reliably identify the CSPA and only the CSPA aircraft so TCAS is neither accidentally inhibited for a non-CSPA aircraft resulting in loss of collision avoidance protection, or not inhibited for a CSPA aircraft, resulting in unwanted alerts.

Discussion: The above issue is largely a technical one. CSPA activation, TCAS inhibition and TCAS re-activation if the approach does not end in a landing should be largely automatic, but status should be communicated to the flight crew. Procedures for managing system failures that result in the CSPA approach being discontinued and TCAS alerts re-activated must be defined. CSPA and TCAS systems will be closely coupled. Requirements on the permissible degree of mismatch between ADS-B and TCAS derived position must be defined.

<u>1.1.2F Responsibility/Authority delegated to Flight Deck</u>
Description: Exactly what authority/responsibility is transferred to the flight deck?

Discussion: The current CSPA concept is "no separation responsibility is transferred to the flight deck; the flight crew has responsibility to maintain their approach course and monitor that the parallel traffic is doing the same. In the rare event of a blunder that threatens the own ship, the flight crew takes evasive action to maintain the safety of the own ship. It already has this authority." This approach is consistent with the direction being taken by the Air Traffic Services, NATCA and ALPA group working the issue for the Applications Sub-Group. We should discuss this further with them.

1.1.2G ATC Notification of and Role during a Blunder

Description: We need to determine how ATC will be “notified” of a blunder. This can be by downlinking the alerts, by having a shadow alerting function on the ground using the same ADS-B information as the aircraft, or waiting for the blunder to become apparent on the controller’s display. Once ATC is aware of a deviation or imminent blunder, what is their role?

Discussion: We should probably assume ATC will also make every attempt to contact the deviating/blundering aircraft, and will issue instructions to try to prevent the blunder, most especially if another aircraft would need to breakout. Deviations due to navigation performance degradation are the most likely cause of deviation from the final approach course. ATC will want to focus on getting that aircraft back on course, but their ability to accomplish this is complicated by the transfer of the lateral surveillance function to the aircraft. This will be discussed with the Air Traffic Services, NATCA and ALPA group noted above.

1.1.2H ATC Resumption of Surveillance Responsibility

Description: In the event of a breakout or missed approach, ATC needs to resume all surveillance responsibility and vector the aircraft back for another approach. What are the requirements for this?

Discussion: In the case of a breakout, the escaping aircraft’s flight path must be in cleared airspace until ATC can issue vectors to assure required separation from other aircraft. Data exists on the probability distribution of time for this to occur, so for the known range of aircraft speeds and rates of climb we can figure out what block of airspace needs to be kept cleared of other traffic. Mitre already calculated that this block would not interfere with downwind traffic at typical downwind to runway lateral distance. However, as noted previously, the time from initiation of the breakout to turn away from the breakout heading should be minimized, so the cleared airspace volume is as small as possible.

The missed approach should be easier to deal with, since there is no blundering aircraft. Either or both aircraft simply execute the published procedure until ATC gives them vectors back into the arrival stream or to another runway. Both missed approach procedures will include a turn away from the parallel traffic, so that ATC will have no problem assuming separation responsibility once the aircraft are clearly separated on the controller’s scope and are diverging. We will need to verify this in both Monte Carlo and piloted simulation. We need to discuss this with and get buy-in from the Air Traffic Services community.

What if the blunder occurs during the missed approach? Is the combined probability of the missed approach (possibly 1 in 100 to 1 in 1000) and the blunder during the missed approach sufficient that it approaches the probability of the blunder during the approach? It would seem likely that the probability of the blunder occurring during a missed approach is greater than during a stabilized approach. The FAA have also raised the question of the normal "dispersion" of aircraft executing missed approaches, which they estimate to be 15^0 meaning that for 2500 ft runway separation, the paths of the aircraft could cross very quickly. This undoubtedly applies to a fleet mix where most missed approaches are hand flown. What difference would a GLS environment in which the missed approach was autocoupled make, or would this requirement be too restrictive? We will use the ASAT model to evaluate whether blunders during the missed approach or the aircraft dispersion during the missed approach need to be considered.